

## A Study on Brick Ballast As Aggregate in Concrete

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**Abstract:** In this study single size aggregate was used to make required strength of concrete to estimate aggregate size as a variable because in actual practice use of one size aggregate is limited. This paper mainly concerned with the properties of the concrete using brick aggregate because of scarcity of the natural aggregate. Three type of cement are used so that it is judged, what kind of cement can be used to get even more good quality of concrete used for constructions Cube and Beam were casted for finding the strength of concrete. It was found that Portland Slag Cement specimen gave the best results. Portland Pozzolana Cement gave second best result and O.P.C exhibited the least compressive and flexural strengths.

**Keywords:** Brick ballast, compressive strength ,flexural strength ,Ordinary Portland Cement, Portland Pozzolana Cement ,Portland slag Cement.

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### I. Introduction

Concrete is a mixture of cement ,sand ,coarse aggregate and water, which can be easily molded into any shape.70-80% volume of concrete is filled with aggregate and it reduces the cost of concrete.But due to geographical constraint it is not available at all places, therefore it necessitates finding other sources and alternatives from local sources.In eastern and northern eastern states of India,burnt clay bricks are used as an alternative source of coarse aggregate. In these places brick aggregate are traditionally used as coarse aggregate are quite extensive and satisfactory for ordinary concrete.

A systematic investigation is required regarding the feasibility of use of crushed brick as aggregate,as the strength of the brick available in the region is much lower than that used by other researchers high water absorption of the brick aggregate in the range of 12-20% by dry weight of brick aggregate also causes a serious problem to use it in the work,though the earlier researchers used S.S.D aggregate in their investigation, But it is not possible to make the aggregate saturated surface dry.

Bricks are the burnt form of clay and when crushed ,it forms aggregate which is known as brick aggregate or brick ballast.These types of aggregates used extensively in many places,where the source of natural aggregates are limited. However these aggregates are porous ,light weighted and also have high water absorption capacity than virgin natural aggregates,which causes low compressive strength and high abrasion value.Despite of all these shortcomings brick ballast has been used in making concrete for many years and previous research shows that by carefully selecting proportion and quality control ,high strength can be achieved in brick aggregate concrete.Brick ballast concrete also performs well or even better than natural aggregate concrete under high temperature. All the studies justified the use of crushed brick as an alternative source of coarse aggregate in concrete.This experimental investigation carried out on concrete made of crushed brick aggregate of designated strength.

### II. Objective

The main objective of this study is to find out the strength and performance of brick ballast concrete.

### III. Materials

#### 1.Cement:

Cement is a binding material which is commonly used in all construction work. Three types of cement are used-

i)**O.P.C**-Ordinary Portland cement of grade 43 conforming to IS 8112-1989 was used.

ii)**P.P.C**-Portland Pozzolana Cement is a blended cement which is produced by grinding of cement clincker (60-80%) along with gypsum and pozzolanic materials (20-40%) like volcanic ash ,calcedclay,flyash,silica fume.

It is highly resisting to corrosion and reduced rate of hardening and lower frost resistant. It is generally used in underground structures.

The compressive strength of PPC as per BIS Code is equivalent to the strength of 33 grade of OPC.

**iii) P.S.C-**Portland slag cement is a hydraulic cement found when granulated blast furnace slag is ground to suitable fineness and is used to replace a portion of Portland cement .Slag cement is commonly found in ready mixed concrete ,precast concrete ,masonry ,soil cement ,high temperature resistant building products.

**2) Bricks-** Clay bricks of 250mmx120mmx70 mm size was used in the investigation before the bricks were crushed down into a coarse aggregate. Their uniaxial compressive strength was recorded for comparison with the aggregate produced by crushing them down to coarse aggregate. The compressive strength of the whole brick is found to be 14.6 MPa.

**3) Brick Aggregate-** Full bricks were crushed to 20 mm nominal size aggregate as per Indian code IS: 383-1970. Tests of mechanically and physical properties were done on the aggregates as per IS:2386-1963, it was found that crushing value of the aggregate 32% and water absorption 10.329% , The fineness modulus of the brick aggregate found to be 7.47, and Specific gravity of coarse aggregate was 2.16.

**4) Admixtures-** A super plasticizing admixture BASF Rheobuild1100i (SNF) as per IS:9103- 1999 was added to the mixing water used, in order to improve workability and to study the effect of admixtures on the properties of fresh and hardened concrete.

#### IV. Methodology

The research paper done on the basis on this working procedure-

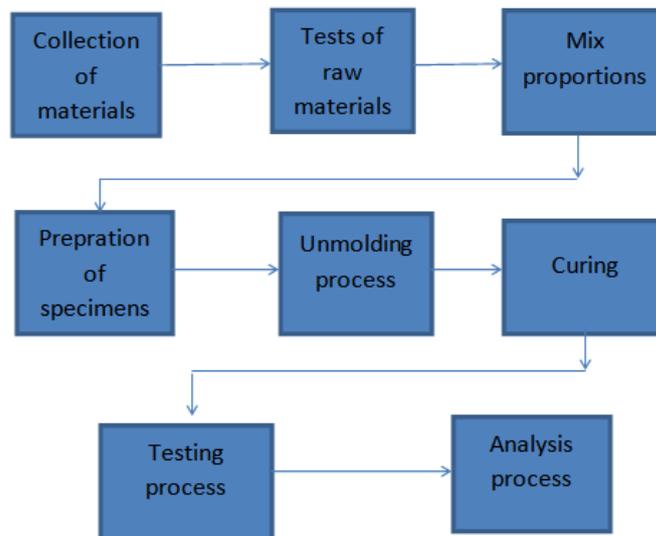


Figure-1 Block diagram of working process

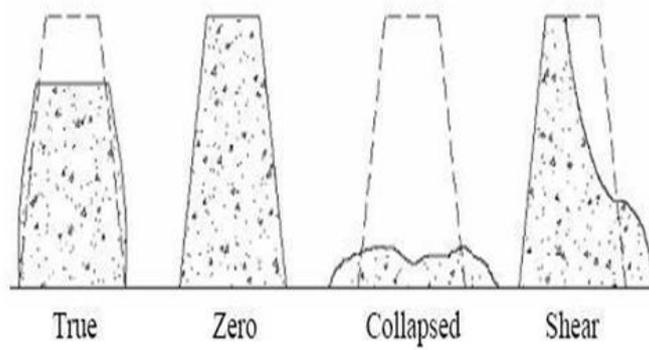
#### V. Laboratory Evaluation

Following tests are conducted on fresh and harden concrete-

**1) Slump test-** Slump test is done to find out the workability of concrete before it harden.

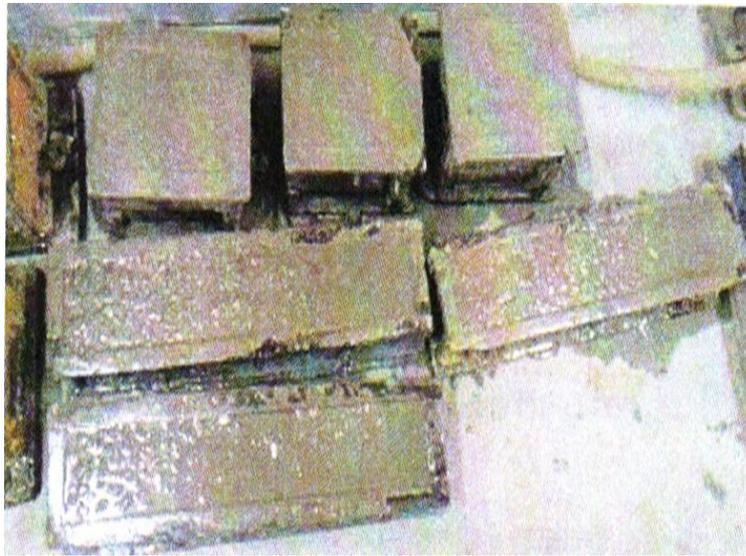


Figure-2 Slump Test Apparatus



**Figure-3** Different Slump Values

**2) Casting of beams and columns-** In the present study M30, M35, M40 grade standard concrete cube and beam of size 150mmX150mmX150mm and of size 500mmX100mmX100mm were cast for determining the compressive strength.



**Figure-4** Casting of Specimen

**3) Curing of specimens-** Curing of specimen are done for 28 days under a reasonable temperature range. Curing increases the strength and reduces permeability.



**Figure-5** Curing of Specimen

**4) Compressive strength test-** Compressive strength of concrete is a measure of concrete ability to resist load which tend to compress it.

**Table-1** Compressive strength of OPC 43 grade

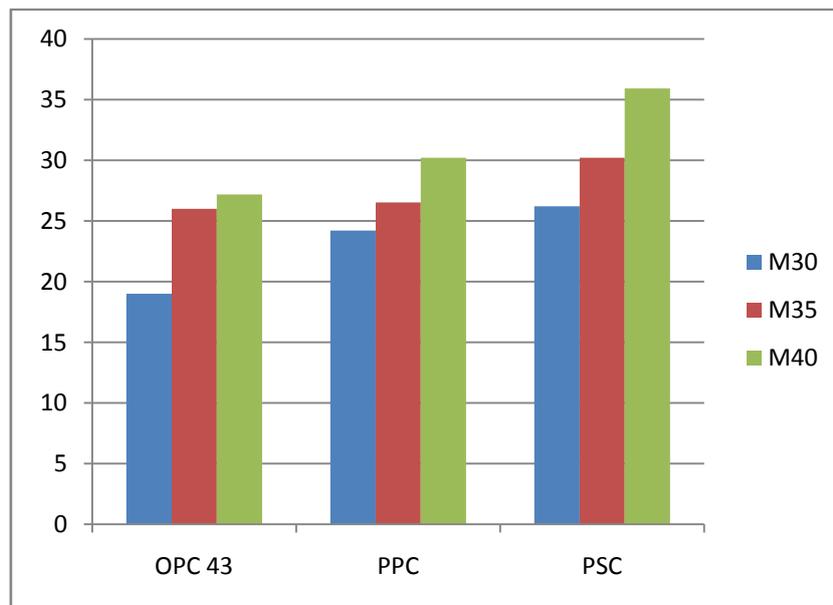
S.N.	Compressive strength of OPC 43 grade		
	M30	M35	M40
1	19	26.67	27.11
2	18	25.56	28.89
3	20	25.75	25.56

**Table-2** Compressive strength of pozzolana Portland cement

S.N.	Compressive strength of pozzolana Portland cement		
	M30	M35	M40
1	25.56	26.67	35.56
2	21.33	26.67	28.44
3	25.78	26.22	26.67

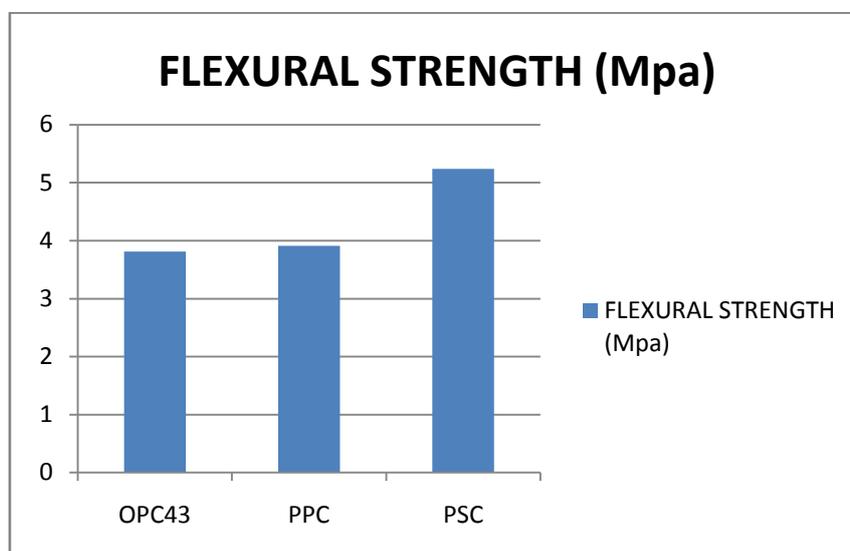
**Table-3** Compressive strength of Portland slag cement

S.N.	Compressive strength of Portland slag cement		
	M30	M35	M40
1	25.78	30.67	35.56
2	26.22	31.11	35.11
3	26.67	28.89	31.11



**Figure-6** Average compressive strength of different cement for different grades of concrete.

**5) Flexural strength-** The flexural strength is basically bending strength. The following graph shows the flexural strength of beam using three type of cement.



**Figure- 7** Flexural strength of different cement

## VI. Result

By the study of different experiments following results are observed-

- The compressive strength of Portland Slag Cement is highest for all the concrete mixes.
- Flexural strength of Portland Slag Cement is more than OPC and PPC.

## VII. Conclusion

The research concludes the study of the effect of brick ballast on the properties of concrete are as follows-

- Brick aggregate have more permeability than natural aggregate and it is the important character of this aggregate and perform better in this regard ,so brick aggregate can be used where load is comparatively less and required more permeability.
- Crushed bricks can be used satisfactory to produce M25 and M 30 concrete keeping water cement ratio in the range of 0.35-0.40.Sufficient workability can be achieved by suitably using the superplasticizer with in a range of .8% -1% by weight of cement.
- Flexural strength can be obtained as per the codal requirement and more. Further study is required for the brick aggregate made from parent brick of different strength.
- About 13%-26% reduction in compressive strength of concrete is found.
- Deformation is large in the brick aggregate than the natural aggregate.

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